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31_Neuroanatomy

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01 - 1. General anatomy of
the brain

1. General anatomy of the
brain

02 - A. Cortical structures

A. Cortical structures

03 - Hemispheric lateralisation

Hemispheric lateralisation

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1. General anatomy of the brain A. Cortical structures The cerebrum has four major lobes (frontal, temporal, parietal and occipital lobes). The lobar surface is heavily folded forming sulci (valleys) and gyri (ridges). Primary (major) sulci are more invariant in their appearance than the secondary (minor) sulci. The central sulcus divides frontal lobe from the parietal lobe. Precentral gyrus (part of the frontal lobe) is the primary motor cortex. The representation of different body parts in this region is often termed as a homunculus. Postcentral gyrus (part of the parietal lobe) is the primary somatosensory cortex with a similar homunculus representation. The lateral sulcus (Sylvian fissure) divides frontal lobe from the temporal lobe. The insula, a structure that is sometimes regarded as the fifth lobe of the cerebrum, is located deep in the Sylvian fissure. Insula is the seat of the primary gustatory cortex. Other major primary sulci include
 2. Superior and inferior frontal sulci: In between these sulci is the middle frontal gyrus constituting the dorsolateral prefrontal cortex, often considered to be responsible for executive functions of the human brain.
 3. Cingulate sulcus on the medial side of the frontal lobe. The anterior portion of the adjoining cingulate gyrus is considered to be the seat of motivation.
 4. Olfactory and orbital sulci on the inferior surface of the frontal lobe. The orbitofrontal cortex is often considered to be the seat of associative learning and decision-making.
 5. The Superior temporal sulcus is forming superior temporal gyrus, the seat of primary auditory cortex.
 6. The interparietal sulcus separates superior and inferior parietal lobes. The inferior parietal lobe is made of the angular gyrus and supramarginal gyrus and is considered to be important for visuospatial attention.
 7. Calcarine sulcus in the medial occipital cortex, the seat of primary visual (striate) cortex
- Hemispheric lateralisation □ Most fundamental brain functions are represented bilaterally. Higher levels of associative functions usually lateralize to one or other hemisphere. For example, language comprehension is localized to the left temporal cortex while prosody (tonal modulation of speech) seems limited to the right hemisphere. □ The hemisphere contralateral to the dominant hand is the dominant hemisphere, and it mediates language and speech functions. □ Dominance can be tested using Annette's

handedness scale or Edinburgh handedness inventory. But handedness is not always same as dominance.

04 - B. Subcortical structures

B. Subcortical structures

05 - Limbic system Papez circuit

Limbic system/ Papez circuit

06 - Medial temporal structures

Medial temporal structures

07 - Basal Ganglia

Basal Ganglia

© SPMM Course □ In right-handed people, the left hemisphere is mostly dominant. In 10% of right-handed people, the right hemisphere is dominant. Among left-handed people only about 20% are right hemisphere dominant, with 64% left hemisphere dominant and 16% showing bilateral dominance. □ Size asymmetry: The planum temporale is a triangular region on the upper surface of the superior temporal gyrus. It is important for language processing and is larger on the left than the right hemisphere in 65% brains. It is probably the most asymmetrical structure in the human brain, with some individuals having a five times larger planum temporale on the left than on the right. This asymmetry is reportedly reduced or reversed (right>left) in schizophrenia.

B. Subcortical structures Limbic system/ Papez circuit □ Broca first described the limbic lobe. Papez and later Maclean assigned the function of emotional processing to limbic structures though this view is challenged in recent times. □ The Papez circuit consists of the hippocampus → fornix → mammillary bodies → mammillothalamic tract → anterior thalamic nucleus → genu of the internal capsule → cingulate gyrus → parahippocampal gyrus → entorhinal cortex → perforant pathway → back to hippocampus □ The boundaries of the limbic system were subsequently expanded outside of the Papez circuit to include the amygdala, septum, basal forebrain, nucleus accumbens, and orbitofrontal cortex. □ The limbic system is thought to be involved in various functions such as mediation of emotional responses (through amygdala), influencing neuroendocrine responses (via hypothalamus) and reward system regulation (via nucleus accumbens). □ The limbic system is often considered to be evolutionarily older than the higher cortical centres. Medial temporal structures □ Include the hippocampus, amygdala, entorhinal and parahippocampal cortex. □ Hippocampus appears to play an important role in memory processes. It is one of the few brain regions where the continuous production of new neurons is noted even in adult life. □ Amygdala appears crucial for fear conditioning and emotional regulation Basal Ganglia □ The basal ganglia are a group of gray matter nuclei forming the largest subcortical structure in the brain. They are involved in the planning and programming of movement, and also have a role in the processes by which an abstract thought is converted into voluntary action Left Hemisphere lesions Right Hemisphere lesions Aphasia Visuospatial deficits Right-left disorientation Anosognosia Finger agnosia Neglect Dysgraphia (aphasic) Dysgraphia (spatial, neglect) Dyscalculia (number alexia) Dyscalculia (spatial) Limb apraxia Constructional apraxia Dressing apraxia

Face recognition (bilateral)

08 - Thalamus

Thalamus

© SPMM Course □ They include striatum made of the caudate nucleus and putamen and pallidum made of globus pallidus. Putamen and globus pallidus are sometimes called lenticular/lentiform nucleus. □ The subthalamic nuclei and the substantia nigra are both functionally related to the basal ganglia but are not considered to be a part of this structure. □ Basal ganglia receive crucial inputs from glutamatergic corticostriatal projection. Alexander described five important circuits involving the basal ganglia. These are □ Motor circuit □ Oculomotor circuit □ Dorsolateral prefrontal circuit (executive) □ Anterior cingulate circuit (motivation) □ Lateral orbitofrontal circuit (social intelligence)

Disorder Nature of basal ganglia dysfunction OCD Volumetric changes and higher blood flow to the caudate nuclei. Increased caudate metabolism in untreated subjects reduces after effective treatment. Tourette's syndrome Striatal dopaminergic dysfunction Huntington chorea Degeneration of the striatum (mainly caudate nucleus) & selective loss of GABAergic neurons Wilson disease Copper deposits in the lenticular nuclei CO poisoning Acute bilateral anoxic damage to basal ganglia Hemiballismus Subthalamic nucleus damage (especially infarction) Parkinsonism Depigmentation of Substantia Nigra; Lewy bodies are seen. Striatal overactivity associated with bradykinesia Fahr's disease Progressive calcium deposition in the basal ganglia. (early onset cases present with schizophreniform psychoses and catatonia; later onset cases exhibit dementia and choreoathetosis) Thalamus □ A large oval mass of grey matter nuclei in the subcortical region, relaying all types of sensory information onto cortex (except olfaction). □ It also relays cerebellar and basal ganglia inputs to the cerebral cortex. □ The thalamus is said to play a crucial role of filtering sensory information in preparation for cortical processing. □ The anterior thalamus is a part of the limbic system. It receives the mamillothalamic tract and fornix and connects to the cingulate cortex. Thus, it relays information from hypothalamus and hippocampus onto the frontal cortex. □ Pulvinar is associated with visual attention. Sleep spindles are generated in the reticular nucleus of the thalamus.

09 - Hypothalamus

Hypothalamus

10 - C. Cerebellum

C. Cerebellum

11 - D. Brain stem and cranial nerves

D. Brain stem and cranial nerves

© SPMM Course Hypothalamus □ The hypothalamus regulates physiological functions such as eating, drinking, sleeping, and temperature regulation. □ The hypothalamus has chemoreceptors that respond to variations in glucose levels, osmolarity, acid balance, etc. It also plays a major role in neuroendocrine control. □ The ventromedial hypothalamus acts as the satiety centre while the lateral hypothalamus is the feeding centre. In animals with a lesion of ventromedial hypothalamus hyperphagia and obesity are noted. C. Cerebellum The cerebellum has the important role of preparing a motor plan and predicting balance needed between muscle groups to carry out the intended action smoothly. Cerebellar lesions produce ataxia and coarse intentional tremors, along with hypotonia, past pointing and pendular knee jerk.

Increasingly the role of the cerebellum in cognitive processes has been appreciated. The term cognitive dysmetria (Andreasen) refers to the difficulty in coordinating and monitoring the process of receiving, processing, and expressing information that could result from disrupted cortico-cerebellar circuitry in schizophrenia.

D. Brain stem and cranial nerves The brain stem is made of the midbrain, pons and the medulla. Most of the cranial nerves (9 out of 12) enter or exit the brain from the brainstem.

The midbrain consists of superior (conjugate gaze control) and inferior colliculi (auditory source localization). The substantia nigra is also located in the midbrain along with periaqueductal grey matter that plays an important role in vocalization and freezing response to threat and in pain suppression. Pons is positioned beneath the cerebellum and surrounds the upper half of the 4th ventricle Medulla surrounds inferior part of the 4th ventricle and is continuous with the spinal cord.

No. Name Anatomical features I Olfactory Runs on the basal surface of frontal cortex without passing through the thalamus. Formed as an outgrowth of forebrain II Optic Also an outgrowth of the forebrain. Relays via thalamus (geniculate body) III Oculomotor Purely motor function. Supplies four of the six ocular muscles IV Trochlear Purely motor function. Supplies superior oblique (ocular muscle) V Trigeminal Both sensory and motor. Transmits facial sensation and controls jaw muscles VI Abducens Purely motor function. Supplies lateral abducens (ocular muscle) INFERIOR OLIVARY

NUCLEUS Inferior olivary nucleus is located in the brainstem and aids in motor coordination by projecting climbing fibers to the contralateral cerebellar cortex via inferior cerebellar peduncle. Inferior olivary lesions lead to appendicular ataxia due to motor incoordination of the contralateral arm and leg. Patients with inferior olivary lesions will fail the finger-nose test, mimicking cerebellar lesion. But unlike cerebellar lesions that result in ipsilateral motor incoordination, the contralateral side is affected in olivary lesions.

12 - E. Spinal Cord

E. Spinal Cord

13 - F. Cerebrospinal fluid

F. Cerebrospinal fluid

© SPMM Course VII Facial Both sensory and motor. Transmits taste sensation and controls facial muscles VIII Vestibular Transmits auditory sensation

Cochlear Transmits balance sensation IX Glossopharyngeal Motor control of pharynx; parasympathetic control of the parotid gland; taste from the back of the tongue. X Vagus Motor control of larynx and pharynx; parasympathetic control of the viscera; visceral sensations. XI Accessory Motor control of neck muscles XII Hypoglossal Motor control of tongue muscles

E. Spinal Cord Unlike cerebrum where grey matter is on the outer surface, in spinal cord grey matter occupies the deeper aspect forming an H shaped column surrounding the CSF. The white matter bundles form anterior, lateral and dorsal columns around the grey matter zone. The dorsal column carries proprioceptive sensory fibres; the anterior and lateral columns are made of ascending spinothalamic tracts carrying touch, pressure, pain and temperature sensations. F. Cerebrospinal fluid CSF is secreted by the choroid plexus in the lateral, third and fourth ventricles and at a rate of 300 ml/day, which is almost protein free. Route: From lateral ventricle to 3rd ventricle via interventricular foramina of Monroe; From 3rd to 4th ventricle via cerebral aqueduct of Sylvius; From 4th ventricle to subarachnoid space via foramen of Magendie (single) and foramina of Luschka (two lateral). The body of the lateral ventricle lies immediately below the corpus callosum, and the two lateral ventricles are separated by septum pellucidum. The third ventricle lies between thalamus and hypothalamus. The fourth ventricle lies above the pons and just below the cerebellum. Obstruction to CSF circulation commonly occurs within third or fourth ventricle (foramen of Monroe), leading to non-communicating hydrocephalus. Impairment of CSF reabsorption in the subarachnoid space due to partial occlusion of the arachnoid villi leads to communicating hydrocephalus.

14 - 2. Blood supply to the
brain

2. Blood supply to the brain

15 - A. Major branches

A. Major branches

16 - B. Effect of lesions

B. Effect of lesions

© SPMM Course 2. Blood supply to the brain A. Major branches The internal carotid artery enters the circle of Willis and divides to form the anterior cerebral and middle cerebral arteries. The anterior cerebral artery supplies the medial and superior strip of the lateral aspect of the cerebral cortex up to the parietal/occipital border. The middle cerebral artery supplies most of the lateral aspect of the cerebral cortex. This includes the Broca's and Wernicke's areas in the dominant hemispheres. The posterior cerebral artery arises from basilar artery and supplies the inferomedial temporal lobe and the occipital lobe. The medulla is supplied by posterior inferior cerebellar arteries and anterior spinal branches of vertebral arteries. Pons is supplied by the basilar artery that runs along the midline of the pons.

B. Effect of lesions

Artery Supply Lesion effects Anterior Cerebral Artery (ACA) Medial surface (ventromedial frontal lobe, the cingulum, the premotor cortex, and medial motor strip) Bilateral infarct produces quadriparesis (legs weaker than arms) and akinetic mutism (ventromedial or cingulate syndrome) Recurrent artery of Huebner (branch of ACA) Head of the caudate nucleus Initially an agitated, confused state; evolves to akinesia, abulia, with mutism and personality changes Anterior branches of the upper division of the Middle Cerebral Artery Lateral prefrontal cortex Planning deficits, impairment of working memory, and apathy. (DLPFC dysfunction)

Anterior communicating artery Basal forebrain Akinesia and personality change (orbitofrontal dysfunction) with a confabulatory amnesia resembling Wernicke-Korsakoff syndrome. Posterior inferior cerebellar artery (PICA) thrombosis Lateral medulla Wallenberg's lateral medullary syndrome. Acute vertigo with cerebellar signs. Ipsilateral face numbness, diplopia, nystagmus, Horner's syndrome and IX/X nerve palsy with contralateral spinothalamic sensory loss and mild hemiparesis. Carotid system TIA Carotid system TIA • Amaurosis fugax (due to blockade of retinal arteries) • Aphasia • Hemiparesis • Hemisensory loss • Hemianopic visual loss Vertebrobasilar TIA Vertebrobasilar TIA • Diplopia, vertigo, vomiting • Choking and dysarthria • Ataxia • Alexia without agraphia • Hemisensory loss • Hemianopic visual loss • Transient global amnesia • Tetraparesis • Loss of consciousness (rare)

17 - 3. White matter pathways

3. White matter pathways

© SPMM Course 3. White matter pathways There are 3 major types of white matter pathways. Projection fibers run vertically connecting higher and lower centres of the brain. Association fibers interconnect different regions within the same hemisphere of the brain. Commissural fibers interconnect similar regions in the opposite hemisphere. Corpus callosum is the largest bundle of fibres that connect the two cerebral hemispheres; the other such bundles are anterior commissure (interconnects olfactory bulbs), posterior commissure (interconnects midbrain pretectal nuclei), hippocampal commissure and habenular commissure (interconnects posterior dorsal thalamic nuclei). The pericallosal artery derived from the anterior cerebral artery provides blood supply to the anterior aspect and most of the body of the corpus callosum. Left sided apraxia and agnosia may be seen in cases of vascular disruption. Posterior cerebral artery territory supplies splenium (posterior aspect of the corpus callosum) and disrupted supply here prevents right visual cortex accessing the dominant hemispheric processes such as language resulting in alexia and color anomia but with preserved ability to copy words as motor information is relayed via anterior corpus callosum Fornix is an important white matter tract that connects hippocampus to the hypothalamus via mammillary bodies. Thus, it relays cortical input to regulate neuroendocrine and autonomic systems. Arcuate fasciculus connects Broca's and Wernicke's areas. Damage results in conduction aphasia. Uncinate fasciculus is a major frontotemporal tract that connects orbitofrontal cortex to the anterior temporal lobes. It plays an important role in social cognition and language.

18 - 4. Cell types in the nervous system

4. Cell types in the nervous system

19 - A. Cortical layers

A. Cortical layers

20 - B. Special neuronal cell types

B. Special neuronal cell types

© SPMM Course 4. Cell types in the nervous system A. Cortical layers The human brain contains approximately 10^{11} neurons (nerve cells) and approximately 10^{12} glial cells. According to the distribution of the various types of neurons (i.e. the cytoarchitecture), Brodmann divided the cortex into 47 'specialised' areas. The neocortex (most of the cerebrum) is made up of six layers, with pial surface above layer 1 to the white matter below layer 6. Layers 2 and 4 are mainly afferent (receiving inputs) while 5 and 6 are mainly efferent (sending outputs). The pyramidal neurons with their triangular-shaped cell bodies make up nearly 75% of the cortical neurons. Stellate cells (25%) are present in all the layers except layer 1.

| Layer Name | Predominant cells |
|--------------------------|---|
| Molecular/agranular | Glial cells, dendrites from neurons of deeper layers and the horizontal cells of Cajal. |
| External Granular layer | Granule cells and small pyramidal cells (these get larger as you move down) |
| External Pyramidal layer | Small and medium sized pyramidal cells. |
| Internal Granular layer | Some pyramidal cells, mostly granule cells. |

Internal Pyramidal layer Largest pyramidal cells (esp. in motor cortex: Betz cells) Multiform layer A mixture of all cells, spindle cells, Martinotti cells. The major source of corticothalamic fibres. Gives rise to association/commissural and projection fibres.

The cerebellar cortex is three layered. The molecular layer consisting of basket cells and stellate cells, Purkinje layer consisting of Purkinje cells and a Granular layer consisting of granule and Golgi cells. B. Special neuronal cell types Purkinje cells are a class of GABAergic neurons located in the cerebellar cortex only. Purkinje cells form the sole output of all motor coordination in the cerebellum they connect to the deep cerebellar nuclei via inhibitory projections. Granule cells are found within the granular layer of the cerebellum, layer 4 of the cerebral cortex, the dentate gyrus of the hippocampus, and in the olfactory bulb. Large pyramidal cells called Betz cells are seen in the primary motor cortex. Betz cells are pyramidal cell neurons located within the fifth layer of the grey matter in the primary motor cortex. These neurons are

21 - C. Glial cells

C. Glial cells

© SPMM Course the largest in the central nervous system, sometimes reaching 100 μm in diameter. Betz cells represent about 10% of the total pyramidal cell population in layer V of the human primary motor cortex. Stellate cells are found in layer IV of the cerebral cortex (from thalamus feeding forward to pyramidal cells) and also in the cerebellum. C. Glial cells These are cells with supportive metabolic functions; they also participate in modulating neuronal functions e.g. via the production of neurosteroids. There are 3 types of glial cells:

1. Astrocytes are the most numerous of the three types. These are star-shaped cells that enable nutrition of neurons, breakdown of some neurotransmitters, and maintaining the blood-brain barrier.
2. Oligodendrocytes are seen in CNS (not in peripheral nerves, where Schwann cells replace them). They produce myelin sheaths that help in saltatory conduction (pole to pole jumping), which quicken the process of signal transmission.
3. The microglia are descendants of macrophages. They are scavenger cells that clear neuronal debris following cell death.
4. Ependymal cells are a special type of glia that cover the ventricles and facilitate CSF circulation via their ciliary processes.

BLOOD BRAIN BARRIER

The blood- brain barrier is located in endothelial cells of capillaries of the brain. Unlike the endothelial cells found elsewhere, brain's endothelial cells have tight junctions with high electrical resistance providing an effective barrier against molecules. In addition, brain capillaries are in contact with foot processes of astrocytes that separate the capillaries from the neurons.

Lipid soluble molecules (ethanol and caffeine) can penetrate the barrier relatively easily via the lipid membranes of the cells. In contrast, water-soluble molecules such as sodium and potassium ions are unable to transverse the barrier without using specialized carrier-mediated transport mechanisms.

Inflammation such as meningitis weakens the blood brain barrier.

There are some areas of the brain that do not have a blood- brain barrier. These are so called circumventricular organs e.g. subfornical organ, area postrema (chemo receptor trigger zone), median eminence and posterior pituitary.

22 - 5. Major neurochemical pathways

5. Major neurochemical pathways

23 - A. Dopaminergic pathways

A. Dopaminergic pathways

24 - B. Cholinergic pathways

B. Cholinergic pathways

© SPMM Course 5. Major neurochemical pathways A. Dopaminergic pathways Depending on the length of the projections, dopaminergic pathways can be classified into

1. Long paths: Nigrostriatal, mesocortical and mesolimbic pathways.
2. Short paths: Tuberoinfundibular and incertohypothalamic pathway.
3. Ultrashort paths: These are found in the amacrine cells in the retina and in the olfactory system. The nigrostriatal pathway is the extrapyramidal pathway that is crucial for motor control; this accounts for most of the brain's dopamine.

Pathway Origin and destination Effect of dopamine (DA) blockade Nigrostriatal Substantia Nigra to striatum and amygdala via medial forebrain bundle DA deficiency (e.g Parkinson's) or blockade due to antipsychotics can cause extrapyramidal side effects Mesolimbic Ventral tegmental area (VTA) to Nucleus accumbens and hippocampus via medial forebrain bundle Blockade of DA in this tract produces the desirable antipsychotic effect by controlling positive psychotic symptoms Mesocortical Ventral tegmental area (VTA) to cingulate cortex and prefrontal regions via medial forebrain bundle Low levels of DA or DA blockade in this tract is associated with negative symptoms (alogia, anhedonia, amotivation and apathy) Tuberoinfundibular Hypothalamus to the pituitary via portal vessels

Dopamine acts as PIH - prolactin inhibitory hormone. DA blockade will serve to increase prolactin levels. Incertohypothalamic Internal connections within hypothalamus Disturbed thermoregulation and possibly weight gain

B. Cholinergic pathways The two major cholinergic pathways are

1. Brainstem pathway: This forms a part of the ARAS - ascending reticular activating system that is important to maintain wakefulness and REM sleep state. It originates from pedunculopontine and laterodorsal tegmental nuclei and innervates thalamic relay neurons and reticular nuclei.
2. Basal forebrain pathway: Originates at the Nucleus Basalis of Meynert in basal forebrain and projects to the hippocampus, frontal cortex and amygdala. Degeneration of this pathway is implicated in Alzheimer's disease.

25 - C. Serotonergic pathways

C. Serotonergic pathways

26 - D. Noradrenergic pathways

D. Noradrenergic pathways

27 - E. Glutamatergic system

E. Glutamatergic system

28 - F. GABAergic system

F. GABAergic system

© SPMM Course C. Serotonergic pathways Most of the brain's serotonergic neurons originate in the midbrain dorsal and median raphe nuclei and ascend to innervate the entire cortex, basal ganglia, thalamus, and also descend to the spinal cord. D. Noradrenergic pathways Noradrenergic projection originates at the locus coeruleus (pons) and ascends to most of the cortex via medial forebrain bundle. Similar to the serotonin system, noradrenergic projections also descend to the spinal cord. E. Glutamatergic system Glutamate is the most common excitatory neurotransmitter in the brain. As a result, almost all cortical descending tracts (from pyramidal cells) rely on glutamate for neurotransmission. This large output of corticofugal fibres makes up most of the corona radiata. All of the association and commissural fibres also use glutamatergic transmission. Many thalamic neurons are also glutamatergic. Thus thalamocortical projections are also glutamatergic. In addition cerebellar output from deep nuclei, subthalamic nuclei to globus pallidus projections, and brainstem to spinal cord projections are also predominantly glutamatergic. F. GABAergic system GABA is the primary inhibitory neurotransmitter in the brain. Unlike other neurotransmitters, there are no specific neurochemical pathways where GABA is dominant. Instead, GABA is the major transmitter for cerebral interneurons that are ubiquitous throughout the cortex. Interneurons are usually short neurons that serve to connect two other neurons, thus forming an essential part of the complex wiring pattern of the cortex. They carry neither motor nor sensory information but serve to modulate local neural circuitry. 2 major cortical interneuron subtypes are noted: parvalbumin (PV)-expressing interneurons (~40% of all interneurons) and somatostatin (SST)-expressing interneurons (30% of interneurons, also called Martinotti cells). A reduction in the expression of PV-interneurons in the frontal cortex is now a well-replicated feature of schizophrenia. PV-interneurons are of 2 subtypes: Basket cells and Chandelier cells. Basket cells receive direct input from thalamocortical projections. They form synapses with the soma or dendrites of the pyramidal neurons and serve to provide the excitatory-inhibitory balance to the cortex. Chandelier cells form synapses with the proximal axonal hillock of pyramidal neurons. They may have an overall excitatory role by serving to short-circuit the action potential propagation though their role is still unclear.

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□ Heide et al. Dissecting the uncinata fasciculus: disorders, controversies and a hypothesis. *Brain*. 2013 Jun;136(Pt 6):1692-707.

□ Ruigrok TJ. Cerebellar nuclei: the olivary connection. *Prog Brain Res*. 1997;114:167-92.

□ Lewis DA et al. Cortical parvalbumin interneurons and cognitive dysfunction in schizophrenia. Trends in Neurosciences 2012 Jan;35(1):57-67. □ Andreasen NC et al. "Cognitive dysmetria" as an integrative theory of schizophrenia: a dysfunction in cortical-subcortical-cerebellar circuitry? Schizophr Bull. 1998;24(2):203-18.

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